

The beetle family Carabidae of Costa Rica: The genus *Epikastea* Liebke of the Plochionida Group, with new Neotropical species and notes on their way of life (Insecta: Coleoptera, Lebiini, Agrina)

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Abstract

Genus *Epikastea* Liebke 1936, of the Plochionida Group of Subtribe Agrina, Lebiini, with six species is revised. Subtribe Agrina consists of those species formerly included in the Subtribe Calleidina. The species of *Epikastea* Liebke 1936 are diagnosed, described, and illustrated. One species occurs in Costa Rica; five are new South American species and are here assigned to this genus. The five new species described are: *Epikastea biolat* Erwin, **n. sp.** (PERÚ, MADRE DE DIOS, Rio Manu, BIOLAT Biodiversity Station, Pakitza Guard Station, 356m, 11° 56' 47" S, 071° 17' 00" W), *Epikastea grace* Erwin, **n. sp.** (PERÚ, LORETO, Samiria River, Camp Manco Capac, 04° 43' 0 S, 074° 18' 0 W), *Epikastea mancacapac* Erwin, **n. sp.** (PERÚ, LORETO, Samiria River, Camp Manco Capac, 04° 43' 0 S, 074° 18' 0 W), *Epikastea piranha* Erwin, **n. sp.** (ECUADOR, ORELLANA, Haurani Territory, Camp Piraña, 0° 39' 25.685" S, 76° 27' 10.813" W), *Epikastea poguei* Erwin, **n. sp.** (PERÚ, MADRE DE DIOS, Rio Manu, BIOLAT Biodiversity Station, Pakitza Guard Station, 356m, 11° 56' 47" S, 071° 17' 00" W). A definition of the Plochionida Group and an identification key to the Western Hemisphere genera included are provided. A key to the known species of *Epikastea* Liebke is given. Distribution data are provided for all species and a map is provided for the Costa Rican taxon. Adults of *Epikastea* Liebke have been found on rotting logs in rainforests and fogged from the canopy of tropical trees and palms.

Key words: Costa Rica, Perú, Ecuador, INBio, Carabidae, Lebiini, *Epikastea* Liebke

Resumen

El género, *Epikastea* Liebke 1936, del Grupo Plochionida de la Subtribu Agrina, Lebiini, con seis especies es revizado. La Subtribu Agrina consiste en aquellas especies formalmente incluidas en la Subtribu Calleidina. Las especies de *Epikastea* 1936 son diagnosticadas, descritas e ilustradas. Una especie ocurre en Costa Rica ; cinco son nuevas especies sudamericanas, asignadas aquí a este gen-

ero. Las cinco nuevas especies descritas son: *Epikastea biolat* Erwin, **n. sp.** (PERÚ, MADRE DE DIOS, Rio Manu, BIOLAT Biodiversity Station, Pakitza Guard Station, 356m, 11° 56' 47" S, 071° 17' 00" W), *Epikastea grace* Erwin, **n. sp.** (PERÚ, LORETO, Samiria River, Camp Manco Capac, 04° 43' 0 S, 074° 18' 0 W), *Epikastea mancocapac* Erwin, **n. sp.** (PERÚ, LORETO, Samiria River, Camp Manco Capac, 04° 43' 0 S, 074° 18' 0 W), *Epikastea piranha* Erwin, **n. sp.** (ECUADOR, ORELLANA, Hauorani Territory, Camp Piraña, 0° 39' 25.685" S, 76° 27' 10.813" W), *Epikastea poguei* Erwin, **n. sp.** (PERÚ, MADRE DE DIOS, Rio Manu, BIOLAT Biodiversity Station, Pakitza Guard Station, 356m, 11° 56' 47" S, 071° 17' 00" W). Una definición del Grupo Plochionida y una clave de identificación para los géneros del hemisferio Occidental que este incluye son provistas. Una clave para las especies conocidas de *Epikastea* Liebke es presentada. Datos de distribución son provistos para todas las especies y para el taxón de Costa Rica, se provee un mapa. Los adultos de *Epikastea* Liebke han sido encontrados sobre troncos en putrefacción en bosques lluviosos y colectados por fumigación en la copa de árboles y palmeras tropicales.

Palabras clave: Costa Rica, Perú, Ecuador, INBio, Carabidae, Lebiini, *Epikastea* Liebke

Introduction

This is the sixth in my new series of papers with diagnoses of new taxa and redescrptions of known taxa in the beetle family Carabidae from Costa Rica (Erwin 2000, 2002, 2004a, 2004b, Erwin et al. 2004) and other Neotropical countries; previous contributions can be found in Erwin (1973a, 1973b, 1974a, 1982, 1991, 1994). A full description of the taxon herein from Costa Rica, including a color image, an up-to-date map of its known distributions, and what is known of the way of life of adults will be posted at the following URL: <http://www.inbio.ac.cr>. The purpose of this paper was to rapidly provide a complete redescription of the single Costa Rican species in a heretofore monobasic genus, so that it was available for the INBio website, thus enhancing the National Biodiversity Inventory Project of Costa Rica. Upon gathering specimens for this task, I discovered adults of five new species from South America collected mostly by insecticidal fogging of rainforest canopies, so those are fully described here along with a key for identification of all known species of *Epikastea* Liebke.

Although this contribution is a faunal treatment rather than one of phylogenetics, a comment about the grouping of taxa in the Plochionida Group is necessary here. By virtue of many attributes, these genera are obviously closely related, as already recognized in part by Chaudoir (1872). However, Chaudoir (*ibid.*) regarded the genera of this group as a "divisio" of his "Callidides" based on structure of mouthparts and form of the tarsomeres. These mouthpart attributes, tarsal form and their vestiture in males, form of the pronotum, and markedly short antennae offer the best support for grouping these genera and will become the bases for a morphologically-based reconstructed phylogeny in the future for all species throughout the ranges of all genera. The Neotropical genera of interest here, based on museum collections I have studied, are distributed widely in the region and revi-

sion of all their species will be needed for a worthwhile phylogenetic study in the future; there are many undescribed species. In addition, there are many old world components and these too will need revision before we will have a satisfactory classification of the Plochionida.

The key provided below for Western Hemisphere genera, at step 7, separates species of *Plochionus* Dejean and *Menidius* Chaudoir. The type species of *Plochionus* Dejean is *P. pallens* Fabricius, a cosmopolitan species that I believe has Old World roots. Several species of the Western Hemisphere have been placed in this genus. However, several attributes of these suggest they are not closely related to *P. pallens* Fabricius, such as form of tarsomere 4, general body form, and distribution of adhesive setae on the tarsi of males. This indigenous New World lineage may need a new name once a rigorous taxonomic review and phylogenetic analysis are accomplished.

Specimens and methods

Methods and species concepts follow those previously described (Erwin and Kavanaugh, 1981; Kavanaugh and Erwin, 1991). The species validation and diagnosis format follows as closely as possible that suggested in Erwin and Johnson (2000) and as used in Erwin (2000, 2004a, 2004b). Measurements of length (ABL, SBL) and width (TW) follow those of Ball (1972) and Kavanaugh (1979): ABL (apparent body length), measured from apex of labrum to apex of longer elytron; SBL (standardized body length), equals the sum of the lengths of the head (measured from apex of clypeus to a point on midline at level of the posterior edge of compound eyes), pronotum (measured from apical to basal margin along midline), and elytron length (measured from apex of scutellum to apex of the longer elytron); and TW, (total width), measured across both elytra at their widest point.

Included in this study are a total of 23 specimens of *Epikastea* Liebke from the National Museum of Natural History, Washington, DC (NMNH), the ALAS Project headquartered at Estación Biológica La Selva, Costa Rica (INBio-OET), and the Liebke Collection in the Academy of Sciences, Warsaw, Poland (WAR). The sole ALAS specimen will be deposited at INBio upon completion of the study. Some duplicates, series permitting, will be deposited in the California Academy of Sciences (CASC) and University of Alberta (UASM) collections. Holotypes of the new Peruvian species will be deposited in the insect collections of the University of San Marcos Natural History Museum, Lima, Peru (MUSM). An additional 332 specimens of Plochionida in an array of five genera were studied to gain perspective on the group's higher-level attributes and to develop the key to genera.

The habitus images of the adult beetles portray most of the character states referred to in the keys provided. Male genitalia illustrations are standard for descriptive taxonomy of carabid beetles. Geographical data are presented for the species based on all known specimens available at the time of manuscript preparation. I also provide a composite map of

current geo-references for the Costa Rican species herein redescribed (Fig. 14). Up to date distribution maps for Costa Rican species will be posted at the website mentioned above and all species will be eventually posted in the Encyclopedia of Life, Smithsonian Institution website (URL: www.eol.si.com).

Common names for species are required in Spanish for the INBio Website; hence they are provided here in English and will be translated into Spanish when posted at the INBio web site. The species list below, as well as arrangement of descriptions that follow is ordered alphabetically by species. Geo-references have been determined from information given on the specimen labels. At INBio, Lambert is customarily used, while I use latitude and longitude. I report here all information available and use the customary *addim* "0" for minutes or seconds that are not available. Specimens illustrated are noted in figure captions by their ADP or BIOLAT/COLE numbers; these in turn link to their geo-reference in the descriptions.

Accounts of taxa

Tribe Lebiini, Subtribe Agrina, Plochionida Group

Diagnosis: Head robust with short occiput and broad neck, gena absent; mandible robust, scrobe large with lower margin markedly flanged; mentum with anterior margin produced; ligula quadrisetose, medial setae longer than lateral ones; antennae short, robust, barely extended to level of humerus; antennomere 3 with apical ring of setae only, antennomere 4 pubescence various, in apical 3/4th, half, or in area of apical setal ring only. Pronotum quadrate, rectangulate, or cordiform with lateral margins moderately to broadly flanged; side of pronotum nearly straight or evenly rounded, not dentiform at anterior setigerous pore. Elytron truncate, margin straight or slightly sinuate, lateral angle rounded, dorsal surface smooth with normal interneurs and intervals (although interneurs may be nearly effaced). Tarsomeres smooth dorsally; tarsomere 4 triangulate, emarginate or bilobed.

Notes: Subtribe Agrina consists of those species formerly included in the Subtribe Calleidina (cf. Lorenz, 1998). The Plochionida Group, by virtue of the attributes above, formally is designated here with the type genus, *Plochionus* Dejean. The heretofore monobasic genus *Epikastea* Liebke was cataloged in a listing of Agrina genera and placed near other genera of Plochionida (Lorenz, 1998). Liebke (1935) in his key to genera that he considered Calleidina listed the Genus *Epikastea*, but he did not designate a type species nor did he later in the same paper treat this new taxon. In Liebke (1936), he formally described the genus as new and designated *E. limonae* Liebke as the type species. In this 1936 paper he compared his specimens with those of *Andrewes[i]ella* Csiki (= *Euproctinus* Leng & Mutchler, see Shpeley, 1986), but did not attempt to place his new genus in a higher-level classification of Carabidae. In his paper of 1935, he keyed *Epikastea* away from other members of the Plochionida, thus I believe he did not know where they should

be classified. Here, I have placed *Epikastea* Liebke in the Plochionida Group based on character agreement with the Diagnosis above.

New world taxa: *Amelus* Chaudoir 1872, *Epikastea* Liebke 1936, *Menidius* Chaudoir 1872, *Phacocerus* Chaudoir 1872, *Plochionus* Dejean 1821.

Key to the Costa Rican Groups of Subtribe Agrina (Lebiini) and the Neotropical genera of the Plochionida Group

(Modified in part from Erwin, Kavanaugh & Moore 2004)

- 1 Elytron at basal third depressed, surface uneven, tuberculate or not, and/or margin of pronotum angulate or subangulate at mid-lateral setiferous pore Cryptobatida Group
- 1' Elytron neither depressed nor tuberculate, surface smooth with normal interneurs and intervals (or interneurs effaced); side of pronotum nearly straight or evenly rounded 2
- 2(1') Antennae short, barely extended to level of humerus. Head and neck robust, mandible robust, scrobe large, lower margin markedly flanged; ligula quadrisetose **Plochionida Group ... 4**
- 2' Antennae longer, extended well-passed level of humerus. Head small to moderately robust, neck narrow, mandible small, scrobe moderate sized, lower margin slightly too moderately flanged; ligula quadrisetose 3
- 3(2') Pronotum tubular, elongate, with beaded margins; head with long occiput and well developed gena; antennomere 3 with apical ring of setae and pubescence **Agrida Group ... *Agra* Fabricius 1801**
- 3' Pronotum quadrate or rectangulate with lateral margins explanate; head with short occiput, gena present or absent, if present then short; antennomere 3 with apical ring of setae only **Calleidida Group ... *Calleida* Latreille & Dejean 1824**
- 4(2) Antennomere 4 mostly pubescent. Tarsomere 4 markedly bilobed. Ultimate labial palpomere slightly depressed, subequal in size to that of ultimate maxillary palpomere (Figs. 1–6) ***Epikastea* Liebke 1936**
- 4' Antennomere 4 with pubescence restricted to distal half or third. Tarsomere 4 triangulate, emarginate or moderately bilobed; ultimate labial palpomere securiform or subsecuriform, wider and shorter than that of ultimate maxillary palpomere 5
- 5(4') Mentum without dentiform projection on anterior margin, margin moderately produced as short and wide truncate projection; elytral intervals markedly convex, interneurs markedly and densely punctate ... (Fig. 11) . ***Phacocerus* Chaudoir 1872**
- 5' Mentum with well developed dentiform projection on anterior margin; elytral intervals flat or slightly convex, interneurs not or very finely and sparsely punctate 6
- 6(5') Pronotum narrowly cordiform, base only slightly broader than head across eyes; body form short and robust; penultimate hind tarsomere triangulate; labrum with anterior margin moderately v-cleft ... (Fig. 9) ***Amelus* Chaudoir 1872**
- 6' Pronotum quadrate or broadly cordiform (semicircular), if the latter base much

- broader than head across eyes; labrum with anterior margin entire, or very slightly emarginate at most 7
- 7(6') Body form markedly broad; pronotum broadly cordiform (semicircular), base much broader than head across eyes; penultimate hind tarsomere deeply emarginate, moderately bilobed ... (Fig. 10) *Menidius* Chaudoir 1872
- 7' Body form narrow, elongate; pronotum quadrate, side margin slightly sinuate, base only slightly broader than head across eyes; penultimate hind tarsomere emarginate (Figs. 7, 8) *Plochionus* Dejean 1821

The species of *Epikastea* Liebke 1936

- Epikastea biolat* Erwin, new species, Perú
Epikastea grace Erwin, new species, Perú
Epikastea limonae Liebke 1936:125, Costa Rica
Epikastea mancicapac Erwin, new species, Perú
Epikastea piranha Erwin, new species, Ecuador
Epikastea poguei Erwin, new species, Perú

Epikastea Liebke 1936

Epikastea Liebke 1936:125. Type species: *Epikastea limonae* Liebke 1936:125, original monotypy.
 Type locality: See below.

Diagnosis. (cf. Figs. 1–6). Head, prothorax, and venter rufescent, elytra dark with pale apical pattern, or in one species concolorous. Head robust, mandible robust, scrobe large, lower margin markedly flanged. Labial palpomere 4 slightly depressed, subequal in size to that of maxillary palpomere 4. Antennae short, barely extended to level of humerus, antennomere 4 pubescent in apical two-thirds. Tarsomere 4 markedly bilobed; males with adhesive setae on front (1–4), middle (1–4) and posterior (3–4) tarsomeres.

Geographic distribution. Known from Costa Rica, Ecuador and Perú.

Notes. The known altitudinal range of these species is between sea level and 350m. These arboreal beetles have been repeatedly collected with fogging techniques. Nevermann collected his two specimens on fallen and rotting dead tree trunks.

Key to the species of *Epikastea* Liebke 1936

- 1 Elytron with disc, extreme lateral margin, and apex pale; humeri, marginal intervals, and subapical band infuscated (Central America) *E. limonae* Liebke

- 1' Elytron with apex pale, extreme lateral margin pale or not, remaining intervals infuscated or elytron unicolorous (South America) 2
- 2(1') Pronotum bicolored, central disc and lateral explanations rufous, lateral disc piceous; elytron with large apical rufous spot and pale margins *E. poguei* Erwin, new species
- 2' Pronotum unicolorous, rufous; elytron unicolorous or with apical spot or band..... 3
- 3(2') Elytron concolorous or with preapical rufotestaceous spot, without apical band..... 4
- 3' Elytron with apical rufotestaceous band 5
- 4(3) Head with course granulate isodiametric microsculpture, surface dull; elytron concolorous; size moderately larger, SBL = 7.45 to 7.5 mm *E. mancapac* Erwin, new species
- 4' Head with fine isodiametric microsculpture, surface shiny; size moderately smaller, SBL = 5.7 to 6.5 mm *E. biolat* Erwin, new species
- 5(3') Elytron markedly elongate and narrow, Ratio PL/EL = 0.31; apical rufotestaceous band of elytron narrow, about the width of two intervals *E. piranha* Erwin, new species
- 5 Elytron shorter and broader, Ratio PL/EL = 0.33; apical rufotestaceous band of elytron broad, about the width of three and a half intervals *E. grace* Erwin, new species

***Epikastea biolat* Erwin, new species**

(Figs. 1, 12)

Holotype. Male. PERÚ, MADRE DE DIOS, Rio Manu, BIOLAT Biodiversity Station, Pakitza Guard Station, 356m, 11° 56' 47" S, 071° 17' 00" W, September (T.L. Erwin & M.G. Pogue)(MUSM: ADP100400).

Derivation of specific name. The specific epithet, *biolat*, is used as a noun in apposition based on the acronym of the Smithsonian Institution's past Program "Biodiversity in Latin America" (BIOLAT) which sought to field-train young Latin American biology students in biodiversity techniques and did so for over 200 of them between 1987 and 1991 in Perú and Bolivia. These beetles were collected under the auspices of the BIOLAT Program.

Common name. Biolat big-headed carabid beetle.

Diagnosis. With the attributes of the genus as described above and pronotum unicolorous, rufous; elytron with preapical spot. Head with fine isodiametric microsculpture; elytron with slightly transverse sculpticells; dorsal surface shiny. Size moderately small.

Description. (Fig. 1). Size small: ABL = 6.2 to 6.6 mm, SBL = 5.7 to 6.5 mm, TW = 2.6 to 2.8 mm. *Color:* Dorsum of head, prothorax and entire venter rufescent; mouthparts, antennomeres 1–4 and legs rufotestaceous; antennomeres testaceous. Metathorasic wings clear. *Luster:* Shiny. *Microsculpture:* Isodiametric meshes throughout, these slightly transverse on elytra. *Head:* Slightly broader across eyes than pronotum; frontal furrows very

short, shallowly impressed proximal to clypeus, margined laterally by well developed carina, surface near carina slightly rugose; eyes large, produced, gena absent; frons and occiput slightly convex; labrum slightly emarginate; labial palpomere 4 depressed, subequal in size to maxillary palpomere 4. *Prothorax*: Pronotum cordiform, moderately convex, depressed along midline, side margins broadly explanate, markedly sinuate anterior to slightly obtuse hind angle, base slightly rounded, not lobed posteriorly. *Pterothorax*: Normal for Agrina, fully winged. *Legs*: Normal for Agrina. *Abdomen*: Sterna normal for Agrina, glabrous, except normal paired ambulatory setae on sterna III–V; males with two and females with 3 pairs long setae on sternum VI. *Male genitalia*: Phallus (Fig. 12) with ostium of 1/4 its length, slightly catopic, apex short, broad and rounded; endophallus without sclerotized attributes, with many trichae. Parameres asymmetric, right very small, left larger.

Dispersal potential. These fully winged beetles have been repeatedly fogged from the rainforest canopy and probably are good dispersers like most arboreal beetles.

Way of life. See under genus. Two adults of this species were fogged from a tree in the genus *Rinorea*, others from suspended dead leaf clumps, dry leaves suspended in bamboo stands, dry *Cecropia* sp. leaves suspended in the canopy, dry *Swartzia* sp. leaves suspended in bamboo stands, and from beating leaves of shrubs along the trails at Pakitza, Perú. The known altitudinal range of this species is 350 m above sea level. Adults have been obtained in June, July, September, and October; hence there is activity by them in both the dry and rainy seasons.

Other specimens examined. Paratypes: 14, PERÚ. MADRE DE DIOS, Rio Manu, BIOLAT Biodiversity Station, Pakitza Guard Station, 356m, 11° 56' 47" S, 071° 17' 00" W, September (T.L. Erwin)(NMNH: male, ADP100410), September (T.L. Erwin & B.D. Farrell)(NMNH: female, ADP100408), September (T.L. Erwin & M.G. Pogue)(NMNH: male, ADP100420, male, ADP100402, male, ADP100404, male ADP100418, female ADP100416, male ADP100400, male ADP100406), June (T.L. Erwin & F. Pfuno)(NMNH: ADP100373), October (T.L. Erwin & M.G. Pogue)(NMNH: male, ADP100412), July (T.L. Erwin & E. & F. Pfuno)(NMNH: female, ADP100371, female ADP100432, female, ADP100414).

Geographic distribution. Known only from the Manu River watershed, Perú.



FIGURE 1. *Epikastea biolat* Erwin n. sp., male, dorsal aspect, specimen # ADP100400.



FIGURE 2. *Epikastea grace* Erwin n. sp., female, dorsal aspect, specimen # ADP0093805.

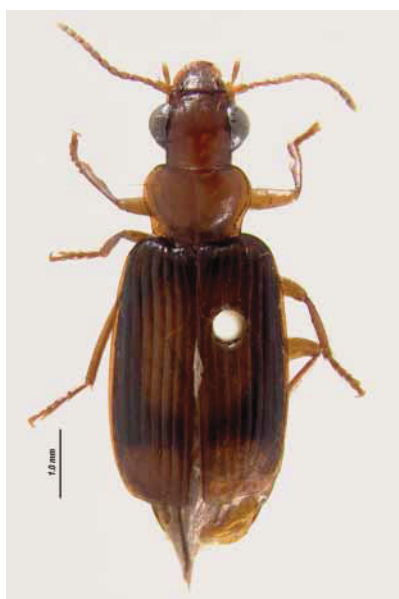


FIGURE 3. *Epikastea limonae* Liebke, female, dorsal aspect, specimen # ADP007958.



FIGURE 4. *Epikastea mancicapac* Erwin n. sp., male, dorsal aspect, specimen # ADP0093-696.



FIGURE 5. *Epikastea piranha* Erwin n. sp., female, dorsal aspect, specimen # ADP108911.



FIGURE 6. *Epikastea poguei* Erwin n. sp., female, dorsal aspect, specimen # BIOLAT/COLE000012611.



FIGURE 7. *Plochionus incultatus* Bates, female, dorsal aspect, specimen # ADP101451, Liberia, Costa Rica.



FIGURE 8. *Plochionus* sp., female, dorsal aspect, specimen # BIOLAT/COLE000012873, Pakitza, Rio Manu, Perú.



FIGURE 9. *Amelus* sp., male, dorsal aspect, specimen # ADP066902, Pakitza, Rio Manu, Perú.

FIGURE 10. *Menidius* sp., male, dorsal aspect, specimen # ADP-100422, Pakitza, Rio Manu, Perú.

FIGURE 11. *Phacocerus* sp., female, dorsal aspect, specimen # BIOLAT/COLE000013035, Pakitza, Rio Manu, Perú.

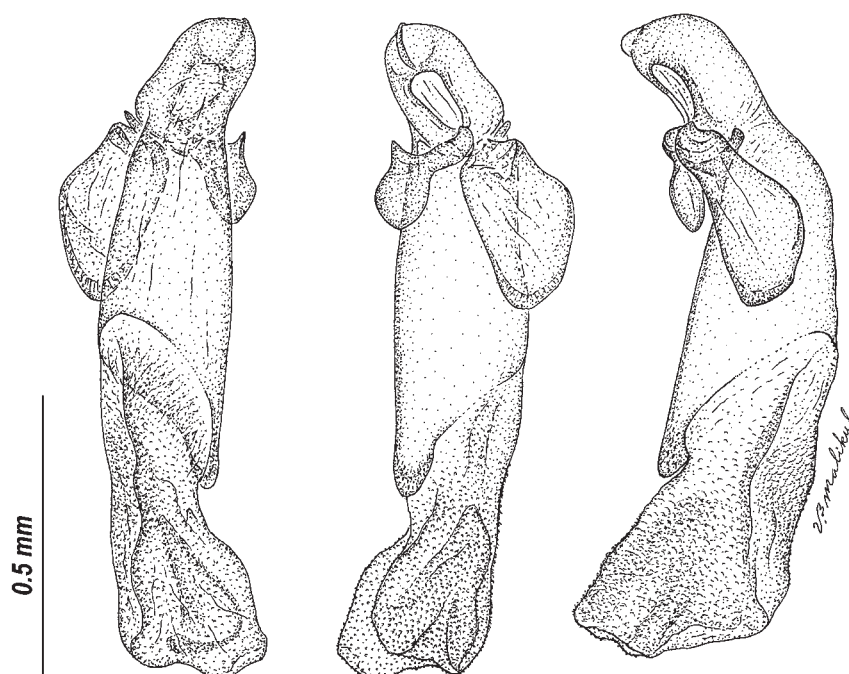


FIGURE 12. Phallus, dorsal, ventral, left lateral aspects of *Epikastea biolat* Erwin n. sp., specimen # ADP100400.

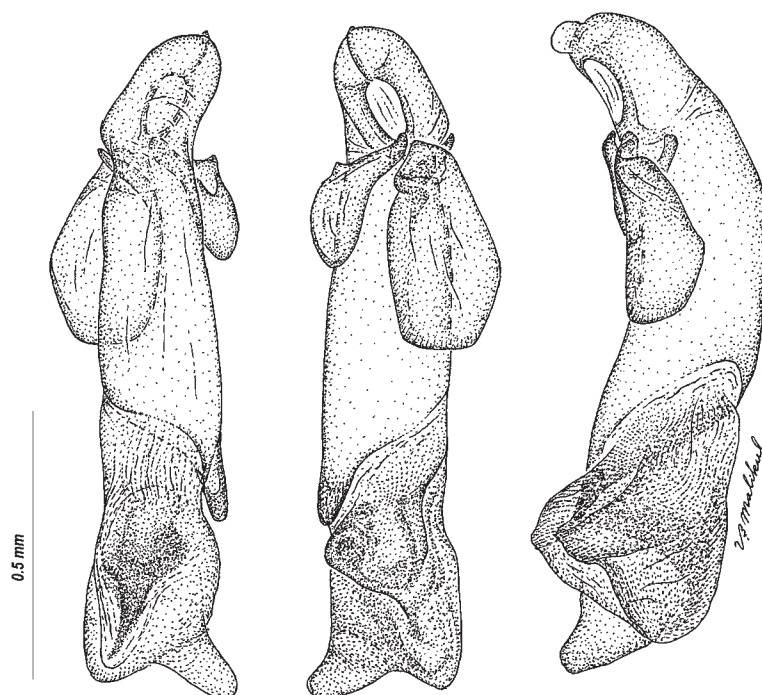


FIGURE 13. Phallus, dorsal, ventral, left lateral aspects of *Epikastea mancopac* Erwin n. sp., specimen # ADP0093696.

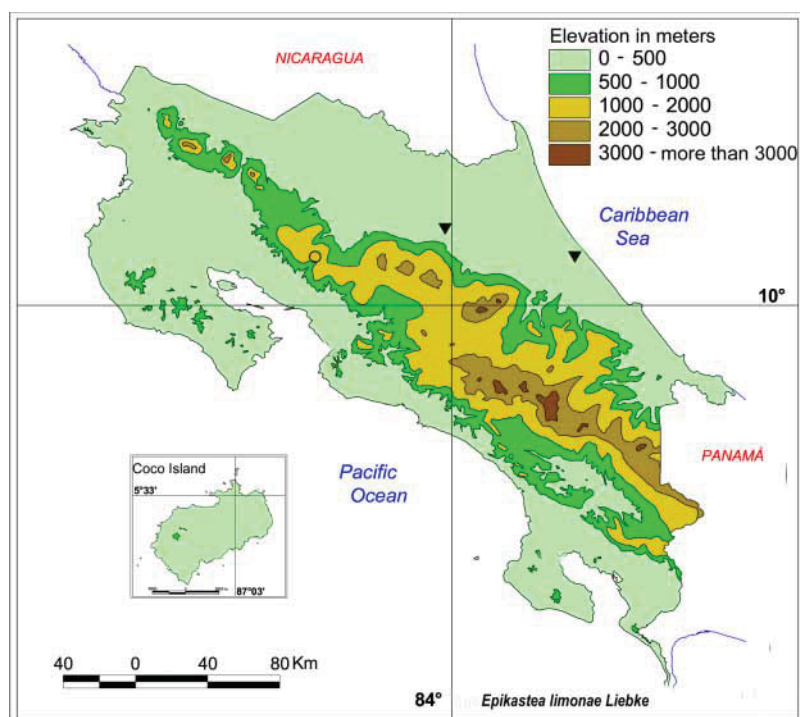


FIGURE 14. Geographical distribution map of the species of *Epikastea* Liebke in Costa Rica: *Epikastea limonae* Liebke (inverted triangle, ▼).

***Epikastea grace* Erwin, new species**
(Fig. 2)

ZOOTAXA

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Holotype. Female, PERÚ, LORETO, Samiria River, Camp Manco Capac, 04° 43' 0 S, 074° 18' 0 W, June (T.L. Erwin, G.P. Servat, et al.)(MUSM: ADP093696).

Derivation of specific name. The specific epithet, *grace*, is used as a noun in apposition based on the name of the collector, Grace Servat, a Peruvian Ornithologist.

Common name. Grace's big-headed carabid beetle.

Diagnosis. With the attributes of the genus as described above and pronotum unicolorous, rufous; elytron with broad apical rufotestaceous band. Head with fine microsculpture, sculpticells isodiametric and slightly transverse. Pronotum and elytron with slightly more impressed microsculpture than head, sculpticells transverse. Dorsal surface very shiny. Elytron proportions normal for genus, Ratio PL/EL = 0.33. Size small for genus.

Description. (Fig. 2). Size small: ABL = 5.9 mm, SBL = 5.5 mm, TW = 2.3 mm. *Color:* Dorsum of head and prothorax and entire venter rufescent; mouthparts, antennomeres, and legs rufotestaceous. Metathorasic wings clear. *Luster:* Dorsal surface very shiny. *Microsculpture:* See Diagnosis. *Head:* Slightly narrower across eyes than pronotum; frontal furrows extended to level of anterior supraorbital seta, moderately impressed proximal to clypeus, margined laterally by well developed carina, surface near carina slightly rugose; eyes large, produced, gena absent; frons and occiput slightly convex; labrum slightly emarginate; labial palpomere 4 depressed, slightly shorter than maxillary palpomere 4. *Prothorax:* Pronotum cordiform, moderately convex, depressed along midline, side margins broadly explanate, markedly sinuate anterior to slightly obtuse hind angle, base slightly rounded, not lobed posteriorly. *Pterothorax:* Normal for Agrina, fully winged. *Legs:* Normal for Agrina. *Abdomen:* Sterna normal for Agrina, glabrous, except normal paired ambulatory setae on sterna III–V; female with 3 pairs long setae on sternum VI. *Male genitalia:* Unknown.

Dispersal potential. This fully winged beetle was fogged from the rainforest canopy, thus adults are probably good dispersers like most arboreal beetles.

Way of life. See under genus, and one adult of this species was fogged from the canopy of a *Mauritia flexuosa* L. palm in Perú. The known altitudinal range of this species is 100m above sea level. An adult was obtained in June; hence there is activity by them in the rainy season.

Other specimens examined. None

Geographic distribution. Known only from the Samiria River watershed, Perú.

Epikastea limonae Liebke

(Figs. 3, 14)

Epikastea limonae Liebke 1936:125. Holotype female in NMNH. Type locality: COSTA RICA. LIMÓN, Rio Reventazon, Ebene, 17km E Siquirres, Waldeck Farm, 10m, 10° 04' 0 N, 083° 18' 0 W, July (F. Nevermann)(NMNH: ADP007958).

Common name. Limón big-headed carabid beetle.

Diagnosis. With the attributes of the genus described above and elytron with disc, extreme lateral margin, and apex pale, humeri, marginal intervals, and subapical band infuscated. Pronotum with margin broadly explanate, width slightly greater than head across eyes; pronotum cordiform-transverse with hind angle slightly obtuse, margin markedly constricted anterior to hind angle; base slightly rounded, not lobed. Elytron without punctulae in interneurs, intervals moderately convex.

Description. (Fig. 3). Size small: ABL = 6.5 to 6.7 mm, SBL = 6.1 mm, TW = 2.6 mm. *Color:* Dorsum of head, prothorax and entire venter rufescent; mouthparts, antennomeres 1–4 and legs rufotestaceous; antennomeres testaceous. Metathorasic wings clear. *Luster:* Shiny. *Microsculpture:* Isodiametric meshes throughout, these slightly transverse on elytra. *Head:* Pronotum subequal in width to head across eyes; frontal furrows very short, shallowly impressed proximal to clypeus; eyes large, produced, gena very short; frons and occiput slightly convex; labial palpomere 4 depressed, subequal in size to maxillary palpomere 4. *Prothorax:* Pronotum cordiform, moderately convex, depressed along midline, side margins broadly explanate, markedly sinuate anterior to slightly obtuse hind angle, base slightly rounded, not lobed posteriorly. *Pterothorax:* Normal for Agrina, fully winged. *Legs:* Normal for Agrina. *Abdomen:* Sterna normal for Agrina, glabrous, except normal paired ambulatory setae on sterna III–V; males with two and females with 3 pairs long setae on sternum VI. *Male genitalia:* Unknown.

Dispersal potential. One fully winged beetle was repeatedly fogged from the rainforest canopy, thus adults are probably good dispersers like most arboreal beetles.

Way of life. These beetles have been found on rotting logs and by fogging the tree *Pourouma minor* Benoist. The known altitudinal range of this species is 10 to 150 m above sea level in lowland rainforest. They have been found only in the lowlands east of the Cordillera Central in January and July indicating they function as adults in both the dry and rainy seasons.

Other specimens examined. COSTA RICA. 1 female, HEREDIA, Estación Biológica La Selva, 3.0 km S Puerto Viejo, Finca La Selva, 50–150m, 10° 25' 55" N, 084° 00' 32" W, LN535500, 268000, January (INBio-OET: CRI002725465); 1 sex not determined, LIMÓN, Rio Reventazon, Ebene, Hamburg Farm, 10m, 10° 15' 0 N, 083° 28' 0 W, July (F. Nevermann)(Liebke Collection, WAR).

***Epikastea mancocapac* Erwin, new species**
(Fig. 4, 13)

ZOOTAXA

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Holotype. Male, PERÚ, LORETO, Samiria River, Camp Manco Capac, 04° 43' 0 S, 074° 18' 0 W, June (T.L. Erwin, G.P. Servat, et al.)(NMNH: ADP093696).

Derivation of specific name. The specific epithet, *mancocapac*, is used as a noun in apposition based on the name of the founder of the Inca Empire, Manco Capac, who was the Sun's son, and the first Inca. He came from Lake Titicaca and had the mission of looking for a good place to found his empire that he did with the help of a silver stick. When this silver stick could penetrate the soil it indicated fertility and it did so at Cerro Huana-caure in Cusco, Perú. Although our camp in the lowlands had nothing to do with Cusco and the Sun's son, the locals saw fit to name the area Manco Capac, so I use their custom and name this species after the name of the local camp.

Common name. Inca big-headed carabid beetle.

Diagnosis. With the attributes of the genus as described above and pronotum unicolorous, rufous; elytron without preapical spot. Head with course granulate isodiametric microsculpture, surface dull. Size moderately large for genus.

Description. (Fig. 4). Size medium: ABL = 7.8 to 10.2 mm, SBL = 7.45 to 7.5 mm, TW = 3.0 to 3.2 mm. *Color:* Dorsum of head, prothorax and entire venter rufescent; mouthparts, antennomeres 1–4 and legs rufotestaceous; antennomeres testaceous. Metathorasic wings clear. *Luster:* Semi-matte on head; pronotum and elytron moderately shiny. *Microsculpture:* Isodiametric meshes throughout, these granular on head and pronotum; slightly transverse on elytra. *Head:* Subequal across eyes to that of pronotum; frontal furrows extended to level of anterior supraorbital seta, moderately impressed proximal to clypeus, margined laterally by well developed carina, surface near carina slightly rugose; eyes large, produced, gena absent; frons and occiput slightly convex; labrum moderately emarginate; labial palpomere 4 depressed, subequal in size to maxillary palpomere 4. *Prothorax:* Pronotum cordiform, moderately convex, depressed along midline, side margins broadly explanate, markedly sinuate anterior to slightly acute hind angle, base slightly rounded, not lobed posteriorly. *Pterothorax:* Normal for Agrina, fully winged. *Legs:* Normal for Agrina. *Abdomen:* Sterna normal for Agrina, glabrous, except normal paired ambulatory setae on sterna III–V; males with two and females with 3 pairs long setae on sternum VI. *Male genitalia:* Phallus (Fig. 13) with ostium of 1/4 its length, slightly catopic, apex slightly elongate, narrowly rounded; endophallus without sclerotized attributes. Parameres asymmetric, right very small, left larger.

Dispersal potential. These beetles have been fogged from the canopy and from a cluster of suspended dry leaves 4m off the ground in a tree and these beetles are fully winged, thus they are likely good dispersers, as are most arboreal beetles.

Way of life. See under genus. One adult of this species was fogged from the canopy of a *Mauritia flexuosa* L. palm and another from a cluster of suspended dry leaves 4m off the ground in a broad leaf tree in Perú. The known altitudinal range of this species is 100m

above sea level. Adults have been obtained in June; hence, there is activity by them in the rainy season.

Other specimens examined. Paratype. Female, PERÚ, LORETO, Samiria River, Camp Manco Capac, 04° 43' 0 S, 074° 18' 0 W, June (T.L. Erwin, et al.)(MUSM: ADP066767).

Geographic distribution. Known only from the Samiria River watershed, Perú.

***Epikastea piranha* Erwin, new species**

(Fig. 5)

Holotype. Female, ECUADOR. ORELLANA, Hauorani Territory, Camp Piraña, 0° 39' 25.685" S, 076° 27' 10.813" W, 216m, January (T.L. Erwin, et al.)(NMNH: ADP108911).

Derivation of specific name. The specific epithet, *piranha*, is used as a noun in apposition based on the name of the camp at which the holotype was collected. In the local language the spelling is Piraña.

Common name. Piraña big-headed carabid beetle.

Diagnosis. With the attributes of the genus as described above and pronotum unicolorous, rufous; elytron with narrow apical rufotestaceous band. Head with fine microsculpture, sculpticells isodiametric and slightly transverse. Pronotum and elytron with slightly more impressed microsculpture than head, sculpticells transverse, more so on elytron. Dorsal surface very shiny. Elytron markedly elongate and narrow for genus, Ratio PL/EL = 0.31. Size small for genus.

Description. (Fig. 5). Size small: ABL = 6.1 mm, SBL = 5.7 mm, TW = 2.3 mm. *Color:* Dorsum of head, prothorax and entire venter rufescent; mouthparts, and legs rufotestaceous, antennomeres 5–11 slightly infuscated. Metathorasic wings clear. *Luster:* Dorsal surface very shiny. *Microsculpture:* See Diagnosis. *Head:* Narrower across eyes than pronotum (eyes deformed in Holotype due to bad collecting fluid); frontal furrows extended to level of anterior supraorbital seta, moderately impressed proximal to clypeus, margined laterally by well developed carina, surface near carina slightly rugose; eyes (probably) large, produced, gena absent; frons and occiput slightly convex; labrum slightly emarginate; labial palpomere 4 depressed, slightly shorter than maxillary palpomere 4. *Prothorax:* Pronotum cordiform, moderately convex, depressed along midline, side margin very broadly explanate, markedly sinuate anterior to slightly right (90°) hind angle, base slightly rounded, not lobed posteriorly. *Pterothorax:* Normal for Agrina, fully winged. *Legs:* Normal for Agrina. *Abdomen:* Sterna normal for Agrina, glabrous, except normal paired ambulatory setae on sterna III–V; female with 3 pairs long setae on sternum VI. *Male genitalia:* Unknown.

Dispersal potential. This fully winged beetles was fogged from the rainforest canopy, thus adults are probably good dispersers like most arboreal beetles.

Way of life. See under genus, and one adult of this species was fogged from the can-

copy of a mixed hardwood rainforest in Ecuador. The known altitudinal range of this species is 216m above sea level. Adults have been obtained in January; hence there is activity by them in the dry season.

Other specimens examined. None

Geographic distribution. Known only from the type locality in Ecuador.

***Epikastea poguei* Erwin, new species**

(Fig. 6)

Holotype. Female. PERÚ, MADRE DE DIOS, Rio Manu, BIOLAT Biodiversity Station, Pakitza Guard Station, 356m, 11° 56' 47" S, 071° 17' 00" W, September (T.L. Erwin & M.G. Pogue)(MUSM: BIOLAT/COLE000012611).

Derivation of specific name. The specific epithet, *poguei*, is used as a noun in apposition based on the name of the collector, Michael G. Pogue, now USDA-SEL Entomologist who supported my studies in the early years as the BIOLAT assistant scientist.

Common name. Mike's big-headed carabid beetle.

Diagnosis. With the attributes of the genus as described above and pronotum bicolorous, rufous with bilateral infuscated patches; head, venter and elytral subapical spot rufous. Head with fine isodiametric microsculpture, surface shiny. Size moderate, SBL = 6.5.

Description. (Fig. 6). Size small: ABL = 6.7 mm, SBL = 6.5 mm, TW = 3.0 mm. *Color:* Dorsum of head and entire venter rufescent; prothorax bilaterally infuscated; mouthparts, antennomeres and legs rufotestaceous; elytral suture, lateral flanges, and subapical spots rufous. Metathorasic wings clear. *Luster:* Shiny. *Microsculpture:* Isodiametric meshes throughout, these mostly effaced on pronotum. *Head:* Subequal in width across eyes to that of pronotum; frontal furrows extended to anterior supraorbital pore, moderately impressed proximal to clypeus, margined laterally by well developed carina, surface near carina slightly rugose; eyes very large, hemispheric, gena absent; frons and occiput nearly flat; labrum slightly emarginate; labial palpomere 4 depressed, subequal in size to maxillary palpomere 4. *Prothorax:* Pronotum cordiform, moderately convex, depressed along midline, side margin broadly explanate, slightly sinuate anterior to marked obtuse hind angle, base slightly rounded, not lobed posteriorly. *Pterothorax:* Normal for Agrina, fully winged. *Legs:* Normal for Agrina. *Abdomen:* Sterna normal for Agrina, glabrous, except normal paired ambulatory setae on sterna III–V; female with 3 pairs long setae on sternum VI. *Male genitalia:* Unknown.

Dispersal potential. The single specimen was collected at black light and is fully winged, thus they are likely good dispersers.

Way of life. See under genus. One adult of this species was collected at black light in September; hence there is activity by them in the late dry season.

Other specimens examined. None.

Geographic distribution. Known only from the Manu River watershed, Perú.

Discussion

For the most part, tropical rainforest carabids are known from those that have been collected with traditional techniques: hand collecting, pitfalls, Malaise traps, beating shrubs and low-hanging branches, black light/Mercury Vapor lights, flight-intercept traps, and night collecting with head lamps. In 1974 in Panamá, I began using an insecticidal fogging technique and this has substantially increased the amounts of specimens representing species of canopy carabids (cf. Ball & Shpeley, 1983, Erwin, 1994, Shpeley & Ball, 1993, 2000). The present paper again demonstrates that this technique is the only way we will truly know the carabid fauna of the rainforest. Because at least half the tropical fauna lives in the trees (Erwin, 1974b), this fogging technique will need to be employed in as many areas as possible for us to understand local and regional carabid species richness and geographical distributions.

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